Butterfly effect

That the flap of a butterfly's wing might lead to a storm or other event halfway around the globe is a popular image used to introduce chaos theory. But two small lepidopterans appear to have played a major part in the scrapping of plans to build a new nuclear power station on a shingle bank in the south-east of England, which is becoming an increasing focus in the International Year of Biodiversity.

Two charities, Butterfly Conservation and Buglife, had highlighted the biodiversity on this shingle bank in Dungeness, the largest in Europe. Scarce and threatened species include the only known British population of the Sussex Emerald moth (*Thalera fimbrialis*) and the largest population of the White Spot moth (*Hadena albimacula*) in the country.

The UK's energy and climate change secretary, Ed Miliband, cited biodiversity and habitat considerations as part of the decision not to go ahead with plans for a new nuclear plant at the site.

Britain has an electricity generation problem looming as several nuclear power stations are due for decommissioning in the next few years. Because coal, once a major source of electricity for the country, is now out of favour because of the greenhouse gas emissions, the government plans to build a new nuclear plant at the site of most of the current plants. But in the early stages of the lengthy consultation and planning process, the proposals for Dungeness have already been abandoned.

The Dungeness site is extraordinary — five kilometres of shingle stretch inland from the sea. Apart from the power station, a few fishermens' houses and huts and fenced areas for the Ministry of Defence mark the area. And a nature reserve is also squeezed in. The film-maker Derek Jarman famously created a driftwood garden around his house here. But the Sussex Emerald moth shuns the conservation areas and is almost wholly found behind the fence of the power plant. Surveys have found the caterpillars on wild carrot plants growing on disturbed land around the plant and not elsewhere. While humans appear to have created the environment these moths prefer, it would take little further activity to wipe them out.

Researchers have studied several other sites in southern England that might be suitable for the moths, but the combination of the right vegetation and stony, partly disturbed land has not been found. Humans have created an

Shingled out: Plans for a second nuclear plant at Dungeness in the UK have been scrapped in part to protect biodiversity in its unique shingle environment. (Photo: PCL/Alamy.)

Wing power: The only known breeding site of the Sussex Emerald moth would have been threatened by a new nuclear plant on the Dungeness shingle bank. (Photo: Roy Leverton.)

environment for the Sussex Emerald here, but conservationists cannot guarantee the long-term future of the species, partly because it is not known what keeps the moths so closely linked to the power station.

The significance of Dungeness will also be marked in other plans for later this year. The site is set to be the site of the reintroduction of a native species of bee. The short-haired bumblebee was once common in southern England but disappeared as a result of changing and intensifying agricultural methods and is on the verge of extinction in the country. But the Royal Society for the Protection of Birds (RSPB), which owns the nature reserve, is planning a reintroduction this year with bees from New Zealand. Bees there were taken by British immigrants and have thrived. Researchers from the RSPB and the Bumblebee Conservation Trust have been working on South Island, collecting queens that are being reared in Christchurch.

Sam Dawes, the RSPB's head of conservation for south-east England said: "The loss of this bumblebee is a prime example of the pressures faced by the UK's natural environment. We've encouraged the flowering plants they love and it is already a haven for many bumblebees, but it is not often you get a chance to bring back a species that has been lost."

Nigel Williams

Q & A

Stuart Pimm

Stuart Pimm is the Doris Duke Professor of Conservation Ecology at the Nicholas School of the Environment, Duke University. He studies the process of species extinction — and how to prevent extinctions. In 2006, the Royal Netherlands Academy of Arts and Sciences awarded him the Dr A.H. Heineken Prize for Environmental Science. His most recent book is The World According to Pimm: A Scientist Audits the Earth.

Why the interest in species extinctions? After my Ph.D., I thought — as did many others — that the right way to study ecology was to find places where ecological processes were intact. After all, the pristine parts of the planet have considerable appeal for many reasons. Fate intervened. I went to Hawai'i, where the lowlands have almost no native flora and fauna, and where the uplands have only a small fraction of their original species. I still feel the shock of this ecological Hell — the ghost of Christmas future, if humanity doesn't do something to change its current destructive practices.

This is where you became a conservation ecologist? Yes, although we didn't have that description back then. I realised that extinction was a massive, ecological problem, and one that responsible ecologists could not ignore.

So scientists should have responsibilities? Absolutely! I have no tolerance for academic dilettantes who feel their own whims are sufficient to spend their time and others' money on trivial problems.

Is there something wrong with pure curiosity? No. Indeed, one of the books that encouraged me to go to Oxford as an undergraduate in 1967 was Niko Tinbergen's *Curious Naturalists*, published in 1958. But what I learned in Hawai'i is that one can be curious about the inescapably important changes to our planet. Extinctions, the patterns of biodiversity, the consequences of climate disruption, the loss of tropical forests and other habitats, all provide hugely interesting scientific questions. And it deeply matters that we answer them.

After Oxford, you went to New Mexico for your Ph.D, right? Yes, to New Mexico State no less, in Las Cruces — a small town back then. I loved it! Not just the desert, not just the wonderful people, but what I learned there too.

There's no question that Oxford had intellectual giants — Tinbergen, David Lack, E.B. Ford, Charles Elton, Bernard Kettlewell, George Varley — and younger colleagues such as John Lawton and Mike Hassell, who played such important roles in shaping what we now call 'evolutionary biology'. Lawton excepted, the focus was largely on single species or pairs of species — their ecology, behaviour and genetics. What I learned in New Mexico was to think about landscapes and broad ecological patterns. I thought, naively, that deserts would be easier places to study greater complexity. And I was much taken with the approach of the IBP — the International Biological Program.

The IBP built computer models of ecosystems, I recall? Yes — and they were total failures. But magnificent failures in their way. It's hard to find any references to IBP in the literature, apart from books on sampling methods. But the idea of comparing different ecosystems — different kinds of deserts or grasslands or grasslands with forests — is a powerful one. And quantifying and modelling their flows of carbon is now a major academic endeavour. New Mexico forced me to think about large-scale processes. I have never stopped.

How did you become interested in food webs? By working for the IBP. The computer model protocol assumed that the 'who eats whom' was known for certain. All one needed to know was the processes that connected the component parts. Those who built the models were from backgrounds — such as engineering — where the connections between the component parts were always well-specified. Nature is much less certain, so I started